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TREE PROSTHESIS FOR CROWN ACCESS

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In equatorial Asia, the emergent dipterocarp trees and several trees in other families flower gregariously, supra-annually (Ashton 1989). We were engaged in a study of the reproduction biology and population genetics of six co-occurring species in *Shorea*, section *Mutica* (Dipterocarpaceae) (Appanah 1981, 1985, 1987; Appanah and Chan 1981, 1982; Chan 1980 a, b, 1981; Chan and Appanah 1980; Gan 1980; Gan et al. 1981). These species flower during the same season at about five year intervals, in overlapping sequence over about two and a half months. A varying proportion of mature individuals flower in a season. Flowers are c. 1 cm in diameter at anthesis, delicate and borne in terminal and axillary inflorescences of the previous flush, in direct sun. Flowers last one day and anthesis is at night; individual trees flower for between 10–20 days, populations for 16–26 days. The first indication of flowering inflorescences become visible from the ground about two weeks before onset of anthesis.

We needed to be able to manipulate flowers, including cross-pollination, of at least three trees more or less simultaneously and in complete security, with both hands and arms free. The requirements of the equipment were therefore that it should be portable, easy and rapid to erect; that it should provide access and freedom to manipulate flowers in the outermost twigs of the exposed part of an isolated emergent crown, and in a way that would permit observation from the outside in; that it should be completely safe, and that it should be cheap and therefore replicable!

FIGURE 1. Bolted tree boom sections, with tufnell sleeve. Pasoh, Malaysia, 1975.

FIGURE 2. Field assistant Mandun with suspension bracket of tree boom. Pasoh, Malaysia, 1975.

FIGURE 3. Tree boom on way up into a Neobalanocarpus heimii (dipterocarp) (full extension). Pasoh, Malaysia, 1975.

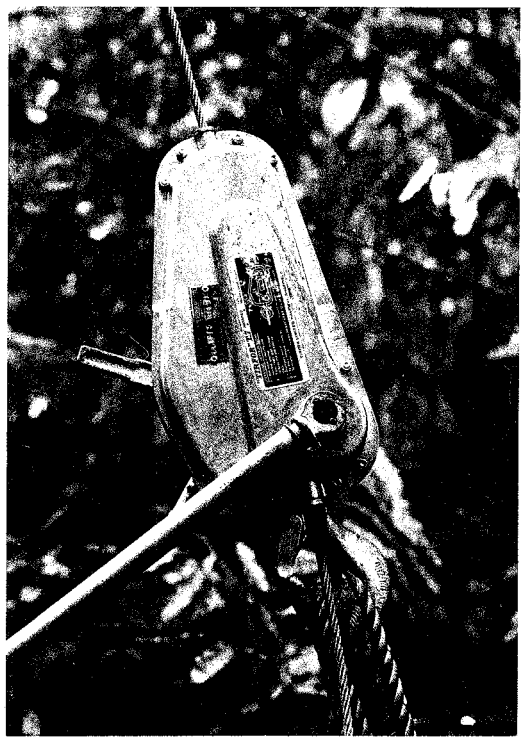

FIGURE 4. Tirfor lifting gear for the boom.

We took the problem to an engineering company familiar with building derricks and lifting gear for the oil industry in the North Sea. Their solution was an artificial tree limb, strong enough to bear the weight of a botanist hoisted on its extremity.

The limbs, or booms, three of which were built for £ 2500 in 1975, consist of up to five standard commercial aluminum alloy tubes, the whole extendible to 22 m overall. The boom can be shortened by using only one, or three of the tubes. The ends of up to two pairs of tubes of declining diameter are slipped one into the other, and into one central tube of diameter c. 25 cm The end of each is made to fit snug into the next by a tooled polyester resin sleeve which is glued into the end of the outer of the tubes (fig. 1). The two are bolted in place. To the extremities of the boom are fitted and bolted a sturdy steel cap with a flange to which may be attached pulleys and ropes (figs. 6, 7).

The boom is lifted by steel hawser, attached to a bracket on its central tube (fig. 2, larger circle in fig. 3). The position of the bracket along the tube can be adjusted, to permit the boom to lie easily at the final angle required, with one upper end penetrating the outer foliage of the crown.

The Achilles heel of the system is the need for a capable tree climber, who must attach a hemp sling at the base of a suitable major canopy branch, from which a pulley is suspended through which the hawser is threaded (small circle in fig. 3). The hawser is then returned to the ground, where it is then threaded into a standard commercial manual lifting gear (fig. 4), which, in turn, is tightly roped onto the base of a nearby tree such that the hawser descends from the pulley at about 45° from the vertical (fig. 5). We found that flying buttresses were ideal for this.

At one end of the boom, generally the lower, is attached a rope by its middle, long enough for both ends to descend from the boom to the ground until and after it is fully hoisted (fig. 6). Operators holding to the ropes continuously adjust the angle and direction of the boom as it ascends in order to avoid snags and to dock the opposite end in the desired position outside the crown. The ropes are then tied to widely separate tree bases to firmly anchor the boom in position for work.

We found that each tube is most conveniently carried by two people. Assembly generally takes

FIGURE 5. The boom in operation.

FIGURE 6. S. Appanah at anchoring end of tree boom.

FIGURE 7. S. Appanah at bosun's chair end of tree boom.

FIGURE 8. Chan H.T. preparing for a night in the canopy. Pasoh, Malaysia, 1975.

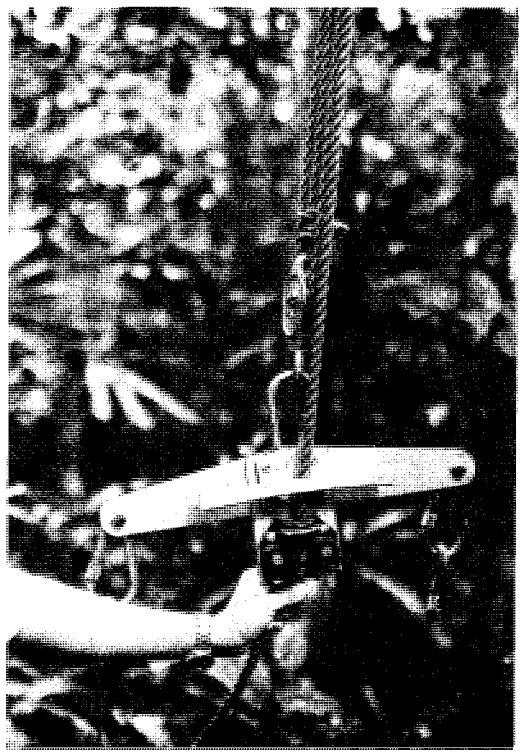

FIGURE 9. T-bar and anchoring gear of bosun's chair.

about six hours, lifting into position and anchoring three hours. Booms can be lowered, transferred up to one kilometer and re-erected comfortably in three days with four assistants.

The researcher should now be able to ascend. Onto the flange at the other end of the boom has been fitted a block and tackle (fig. 7) which will bear the researcher strapped securely into a bosun's safety harness (fig. 8). We arranged the rope system such that an extra person, on the ground, is needed to lift the researcher, as a safety measure to ensure that no one operates the boom alone. The harness is suspended from a T-bar which is attached to the pulley to which one end of the lifting tackle is tied, and through which it is threaded (fig. 9). The other end, which is pulled to lift the researcher, passes by way of an eye between two polyester resin cleats which prevent the rope from slipping back during ascent. There is a further bar for making fast the rope when the researcher is in final position. On descent, the researcher releases the rope from the cleat but winds it one turn round the fastening bar to control the rate at which it is played out. The researcher has freedom to adjust the vertical position by pulling in or letting out the rope. Additional connector links on the canvas seat of the harness provide for the researcher to heave the harness to one side, using ropes or a boathook. If necessary, the researcher can descend and when the boom can then be maneuvered into another part of the same crown.

The prosthesis thereby permitted S.A. and H. T. C. to spend tranquil hours suspended beneath the stars, with arms free to manipulate the tiny flowers—even upside down. P.S.A., regrettably, has a poor head for heights.

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